

SHARP

No.	LD-20852A
DATE	Aug. 07.2008

REVISED

TECHNICAL LITERATURE

FOR

TFT - LCD module

MODEL No. LQ164D1LDxx

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ENGINEERING DEPT.I
MOBILE LIQUID CRYSTAL DISPLAY DIVISION .III
MOBILE LIQUID CRYSTAL DISPLAY GROUP
SHARP CORPORATION

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1. Application

This technical literature applies to a color TFT-LCD module, LQ164D1LDxx.

2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit and power supply circuit and a backlight unit. Graphics and texts can be displayed on a $1600 \times 3 \times 900$ dots panel with 262,144 colors by using LVDS (Low Voltage Differential Signaling) to interface and supplying +3.3V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

In this TFT-LCD panel, low reflection / color filters of excellent color performance and backlights of high brightness are incorporated to realize brighter and clearer pictures, making this model optimum for use in multi-media applications.

Optimum viewing direction is 6 o'clock.

Backlight-driving DC/AC inverter is not built in this module.

3. Mechanical Specifications

Parameter	Specifications		Unit
Display size	41.7(16.4")	Diagonal	cm
Active area	363.2 (H) \times	204.3(V)	mm
Pixel format	1600(H) \times 900(V) (1 pixel = R+G+B dots)		pixel
Aspect ratio	16 : 9		
Pixel pitch	0.227(H) \times 0.227 (V)		mm
Pixel configuration	R,G,B vertical stripe		
Display mode	Normally white		
Surface treatment	Glare and hard-coating 2H		

Parameter	Min.	Typ.	Max.	Unit
Unit outline dimensions [Note 1]	Width	374.5	375.0	mm
	Height	218.6	219.1	mm
	Depth	—	6.5	mm
Mass	—	595	615	g

[Note 1] excluding backlight cables.

Outline dimensions is shown in Fig.2

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4. Input Terminals

4-1. TFT-LCD panel driving

CN1 (LVDS signals and +3.3V DC power supply)

Pin No.	Symbol	Function	Remark
1	GND		
2	Vcc	+3.3V power supply	
3	Vcc	+3.3V power supply	
4	NC		[Note 3]
5	NC		[Note 3]
6	NC		[Note 3]
7	NC		[Note 3]
8	RxIN0-	Receiver signal of LVDS CH0 (-)	[Note 1]
9	RxIN0+	Receiver signal of LVDS CH0 (+)	[Note 1]
10	GND		
11	RxIN1-	Receiver signal of LVDS CH1 (-)	[Note 1]
12	RxIN1+	Receiver signal of LVDS CH1 (+)	[Note 1]
13	GND		
14	RxIN2-	Receiver signal of LVDS CH2 (-)	[Note 1]
15	RxIN2+	Receiver signal of LVDS CH2 (+)	[Note 1]
16	GND		
17	CK IN-	Receiver signal of LVDS CLK (-)	[Note 1]
18	CK IN+	Receiver signal of LVDS CLK (+)	[Note 1]
19	GND		
20	NC		[Note 3]
21	NC		[Note 3]
22	GND		
23	NC		[Note 3]
24	NC		[Note 3]
25	GND		
26	NC		[Note 3]
27	NC		[Note 3]
28	GND		
29	NC		[Note 3]
30	NC		[Note 3]

[Note 1] Relation between RxIN*i*(*i*=0,1,2) and actual data is shown in following section (4-2)(7-2).

[Note 2] The shielding case is connected with signal GND.

[Note 3] Please use NC by OPEN or GND. NC terminal is not connected with the internal circuit.

Using connector : FI-XPB30SRL-HF11 (JAE) or equivalent.

Corresponding connector : FI-X30M,FI-X30ML or FI-X30H (JAE)

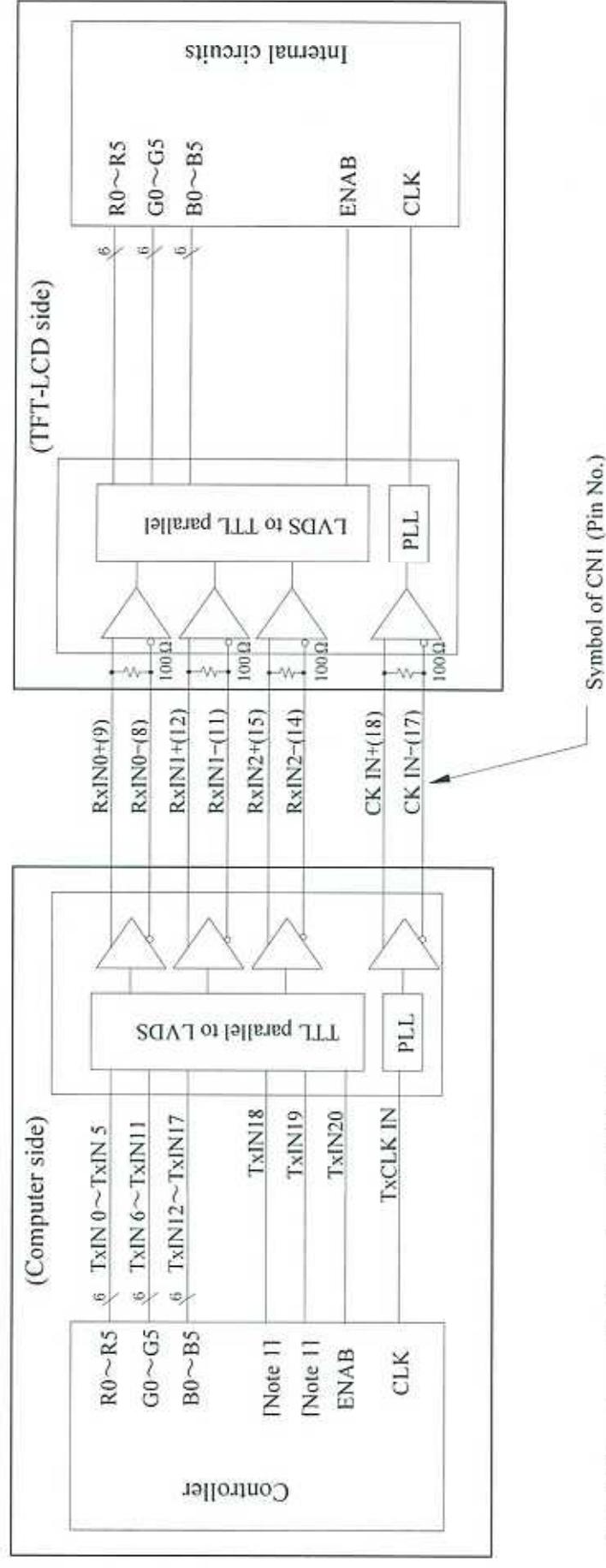
(Sharp is not responsible to its product quality, if the user applies a connector not corresponding to the above model.)

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4-2 LVDS interface block diagram

Using receiver : Single LVDS interface contained in a control IC

Corresponding Transmitter : THC63LVDM63A (THINE) or equivalent



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4-3. Backlight driving

CN2 Using connector:BHSR-02VS-1(JST)

Corresponding connector : SM02B-BHSS-1-TB(JST)

(Sharp is not responsible to its product quality, if the user applies a connector not corresponding to the above model.)

Connector No.	Pin No.	Symbol	Function	FL cable color
CN2	1	V _{High}	Power supply for lamp (High voltage side)	Blue
	2	V _{Low}	Power supply for lamp (Low voltage side)	Black

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings		Unit	Remark
			Min.	Max.		
Input voltage	V _I	T _a =25°C	-0.3	V _{cc} +0.3	V	[Note 1]
+3.3V supply voltage	V _{cc}	T _a =25°C	0	+4.0	V	
Lamp voltage	V _{La}	T _a =25°C	—	2000	V _{rms}	[Note 2]
Storage temperature	T _{stg}	—	-25	+60	°C	[Note 3]
Operating temperature (Ambient)	T _{opa}	—	0	+50	°C	

[Note 1] LVDS signals

[Note 2] Lamp(CCFT) voltage

[Note 3] Humidity : 95%RH Max. at T_a≤+45°C.Maximum wet-bulb temperature at +44°C or less at T_a>+45°C.

No condensation.

6. Electrical Characteristics

6-1.TFT-LCD panel driving

T_a=+25°C

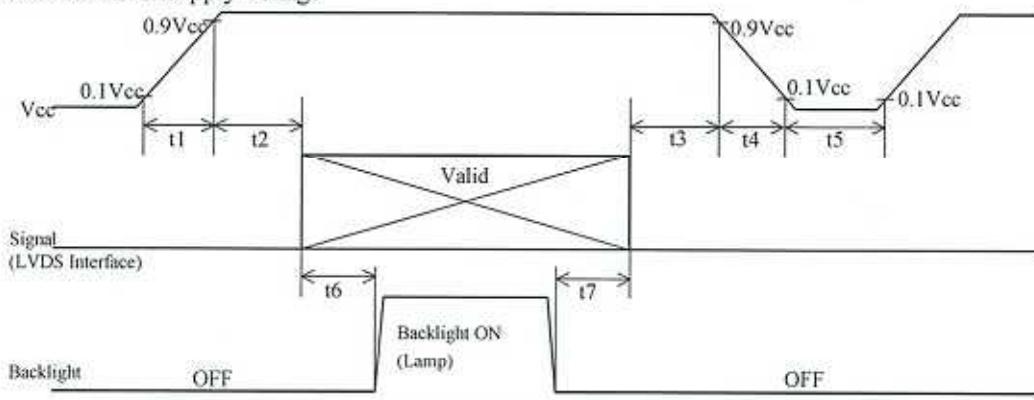
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply voltage	V _{cc}	+3.0	+3.3	+3.6	V	[Note 2]
Current dissipation	I _{cc}	—	290	450	mA	[Note 3]
Permissive input ripple voltage	V _{RP}	—	—	100	mV _{p,p}	V _{cc} = +3.3V
Input voltage range	V _I	0	—	2.4	V	LVDS signals
Differential input threshold voltage	High V _{TH}	—	—	+100	mV	V _{CM} = +1.2V
	Low V _{TL}	-100	—	—	mV	[Note 1]
Input current (High)	I _{OH}	—	—	±10	μA	V _I = +2.4V V _{cc} = +3.6V
Input current (Low)	I _{OL}	—	—	±10	μA	V _I = 0V V _{cc} = 3.6V
Terminal resistor	R _T	—	100	—	Ω	Differential input

[Note 1] V_{CM} : Common mode voltage of LVDS driver.

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[Note 2]

On-off conditions for supply voltage



Symbol	Min.	Max.	Unit	Remark
t1	0	10	ms	
t2	0	1	s	
t3	0	1	s	
t4	0	400	ms	
t5	200	—	ms	
t6	180	—	ms	*1
t7	5	—	ms	*1

*1 : As for the power sequence for backlight, it is recommended to apply above mentioned input timing. If the backlight is lit on and off at a timing other than shown above, displaying image may get disturbed. This is due to variation of output signal from timing generator when LVDS signal is changed from on to off or vice versa, but has no harm to the module itself.

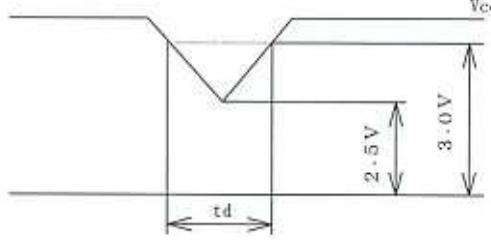
[Note] Do not keep the interface signal high-impedance or unusual signal when power is on.

Vcc-dip conditions

1) $2.5 \text{ V} \leq \text{Vcc} < 3.0 \text{ V}$
 $\text{td} \leq 10 \text{ ms}$

Under above condition, the display image should return to an appropriate figure after Vcc voltage recovers.

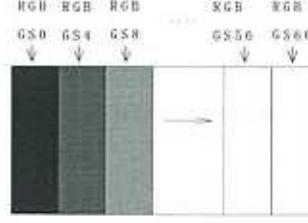
2) $\text{Vcc} < 2.5 \text{ V}$
Vcc-dip conditions should also follow the On-off conditions for supply voltage



[Note 3] Typical current situation : 16-gray-bar pattern.

$\text{Vcc} = +3.3 \text{ V}$

Maximum current situation : $\text{Vcc} = +3.0 \text{ V}$



6-2. Backlight driving

The backlight system is edge-lighting type with single CCFT (Cold Cathode Fluorescent Tube).

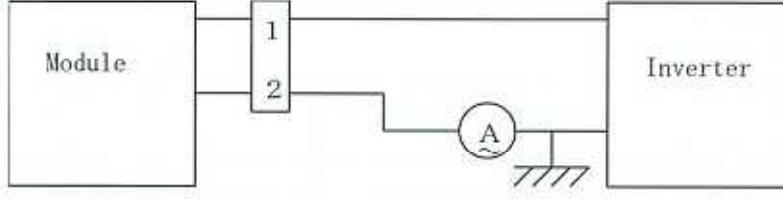
The characteristics of one lamp are shown in the following table.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp current range	I_L	3.0	6.0	6.5	mArms	[Note 1]
Lamp voltage	V_L	—	725	—	Vrms	
Lamp power consumption	P_L	—	4.4	—	W	[Note 2]
Lamp frequency	F_L	40	58	80	kHz	[Note 3]
Kick-off voltage	V_S	—	—	1392	Vrms	$T_a=25^\circ C$
		—	—	1600	Vrms	$T_a=0^\circ C$
Lamp life time	L_L	12000	—	—	Hour	[Note 5]

[Note 1] The lamp current range, which can be turned on, is shown.

Lamp current measures by connecting the ammeter for high frequency to the V_{LOW} side in the circuit of the following figure.

- Lamp frequency : 40~80kHz
- Temperature (Ambient) : 0~+50°C



* 2pin is V_{LOW}

In addition, please check lighting starting nature and lighting stability after mounting a module and an inverter on the occasion of use in a low current region.

[Note 2] Calculated value for reference ($I_L \times V_L$)

[Note 3] Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached as much as possible from the horizontal synchronous frequency and from the harmonics of horizontal synchronous to avoid interference.

[Note 4] It is defined at 22pF for the ballast capacitor of a DC/AC inverter.

The voltage above this value should be applied to the lamp for more than 1 second to start-up. Otherwise the lamp may not be turned on.

[Note 5] Above value is applicable when lamp is placed horizontally.

Lamp life time is defined that it applied either ① or ② under this condition
(Continuous turning on at $T_a=25^\circ C$, $I_L=6.5mArms$)

- ① Brightness becomes 50% of the original value under standard condition.
- ② Kick-off voltage at $T_a=0^\circ C$ exceeds maximum value, (1,600)Vrms.

(Lamp life time may vary if lamp is in portrait position due to the change of mercury density inside the lamp.)

Lamp life time shortens according to the state of mounting and use.

In case of operating under lower temp environment, the lamp exhaustion is accelerated and the brightness becomes lower.(Continuous operating for around 1 month under lower temp condition may reduce the brightness to half of the original brightness.)

[Note 6] The performance of the backlight, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter (miss-lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

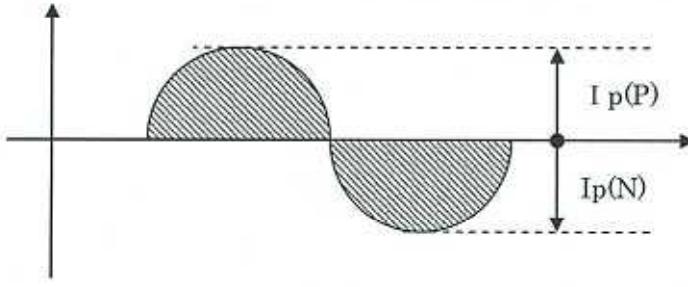
Be sure to use a back light power supply with the safety protection circuit such as the detection circuit for the excess voltage, excess current and or electric discharge waveform.

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[Note 7] Insulate the high voltage area in order to prevent direct contacts to the area. As countermeasures for excessive heat or exothermic fire, use protection elements such as fuses to cut the circuit. Use burn-resistant (or noncombustible) material for board or resin.

[Note8] A lamp waveform should satisfy the following conditions.

Crest factor : $1.20 \leq I_p(P) / I_{rms} \text{ or } I_p(N) / I_{rms} \leq 1.63$
 Imbalanced value: $0.95 \leq I_p(P) / I_p(N) \leq 1.05$



6-3. LVDS input specification

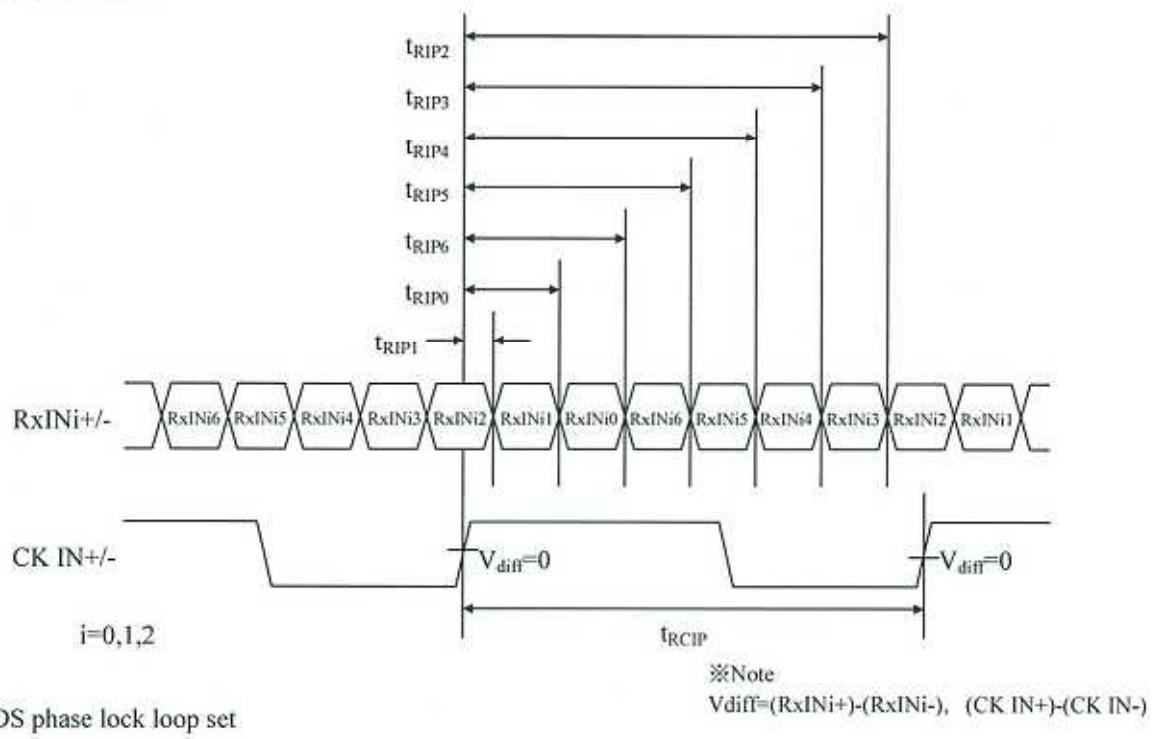
6-3-1. AC characteristics

Vcc=+3.0V~+3.6V, Ta=0°C~+50°C

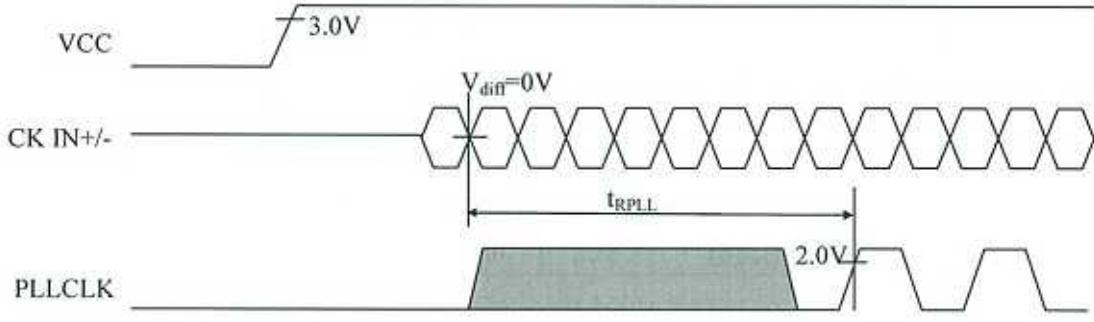
Parameter	Symbol	Min	Typ.	Max.	Unit
Input Data Position 0 (tRCIP=15.38ns)	t _{RIPI}	-0.25	0.0	+0.25	ns
Input Data Position 1 (tRCIP=15.38ns)	t _{RIPO}	t _{RCIP} /7-0.25	t _{RCIP} /7	t _{RCIP} /7+0.25	ns
Input Data Position 2 (tRCIP=15.38ns)	t _{RIP6}	2 t _{RCIP} /7-0.25	2 t _{RCIP} /7	2 t _{RCIP} /7+0.25	ns
Input Data Position 3 (tRCIP=15.38ns)	t _{RIP5}	3 t _{RCIP} /7-0.25	3 t _{RCIP} /7	3 t _{RCIP} /7+0.25	ns
Input Data Position 4 (tRCIP=15.38ns)	t _{RIP4}	4 t _{RCIP} /7-0.25	4 t _{RCIP} /7	4 t _{RCIP} /7+0.25	ns
Input Data Position 5 (tRCIP=15.38ns)	t _{RIP3}	5 t _{RCIP} /7-0.25	5 t _{RCIP} /7	5 t _{RCIP} /7+0.25	ns
Input Data Position 6 (tRCIP=15.38ns)	t _{RIP2}	6 t _{RCIP} /7-0.25	6 t _{RCIP} /7	6 t _{RCIP} /7+0.25	ns
Phase Lock Loop Set	t _{RPLL}	—	—	10	ms
Input Clock Period	t _{RCIP}	11.1	11.2	14.3	ns

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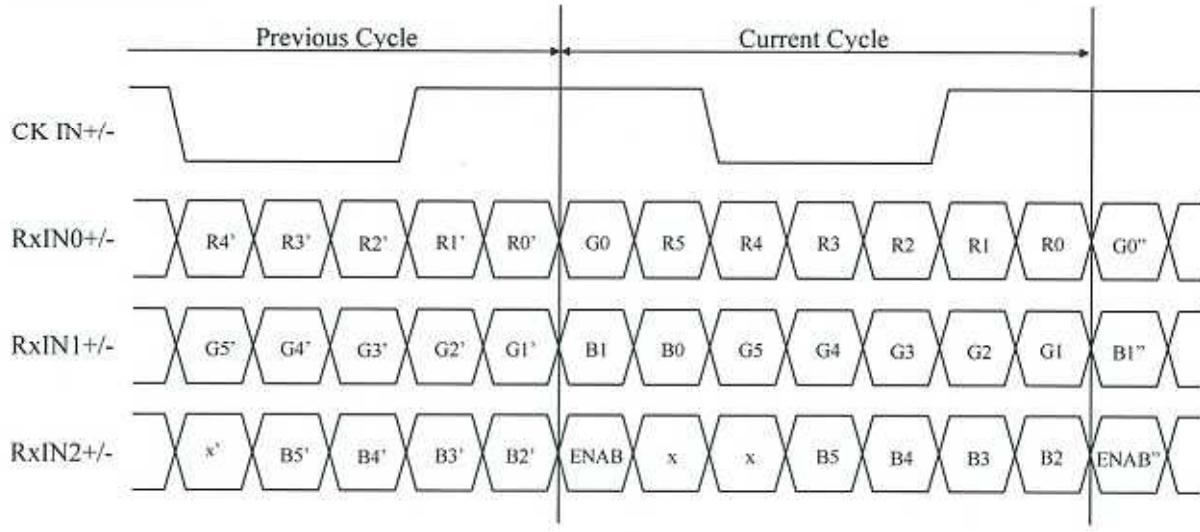
LVDS input timing



LVDS phase lock loop set



6-3-2.LVDS data



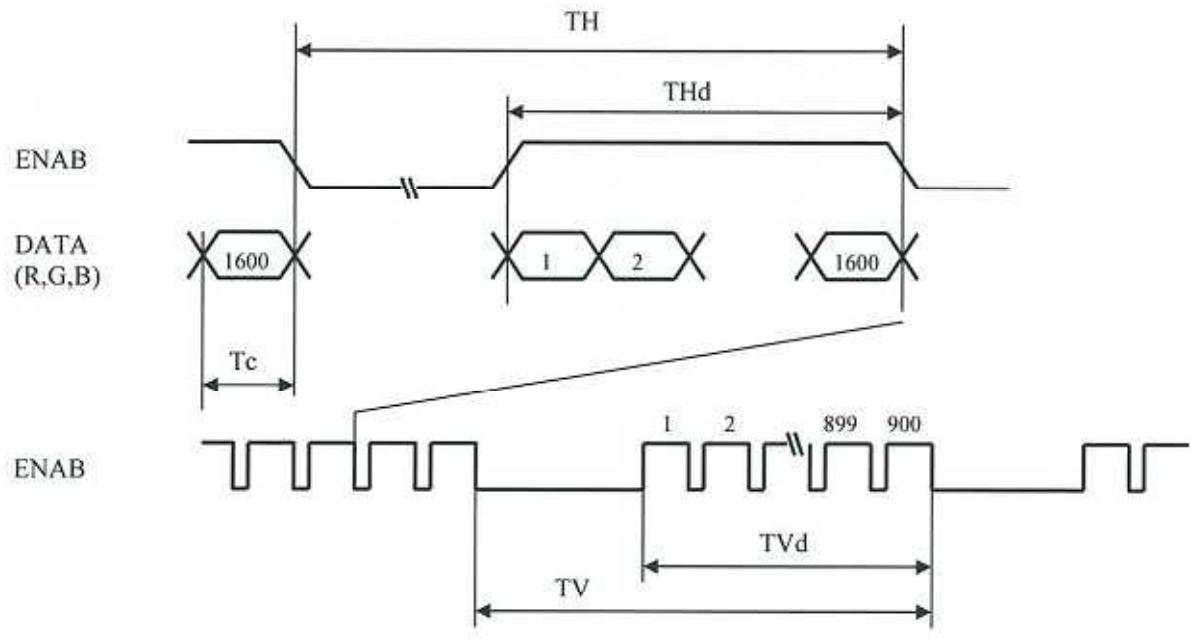
7. Timing Characteristics of Input Signals

7-1. Timing characteristics

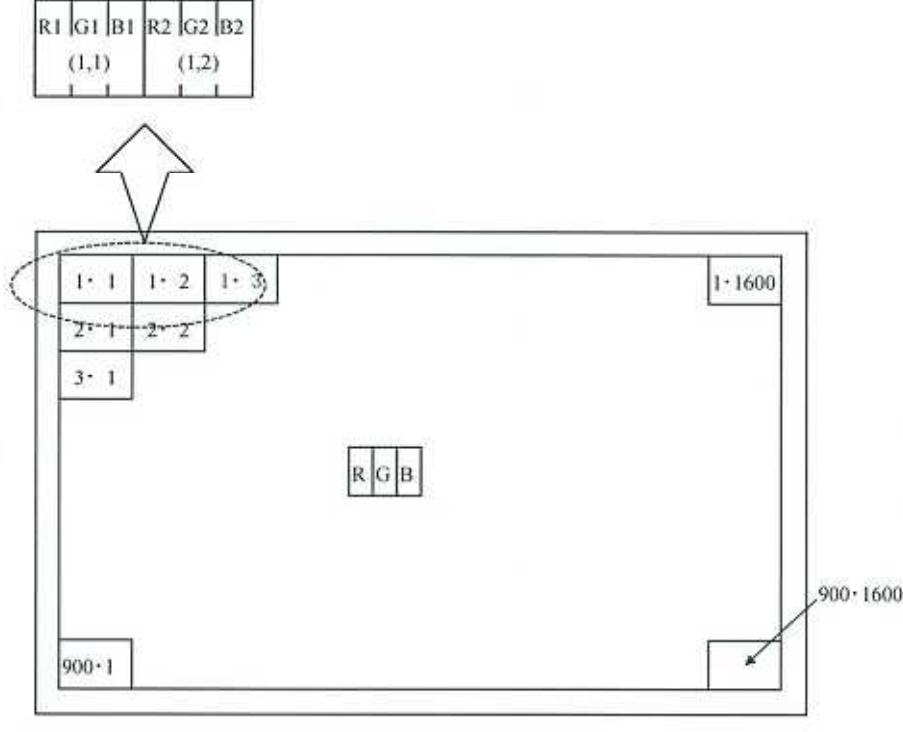
Vcc=+3.0V~+3.6V, Ta=0°C~+50°C

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Clock	Frequency	I/Tc	70	89.4	90.3	MHz	[Note 1]
Data enable Signal	Horizontal period	TH	1630	1650	1940	clock	
			18.23	18.46	—	μs	
	Horizontal period (High)	THd	1600	1600	1600	clock	
	903		903	1010	Line		
	Vertical period	TV	16.67	16.67	—	ms	
			900	900	900	line	

[Note 1] In case of using the long vertical period, the deterioration of display quality, flicker, etc, may occur.



7-2. Input data signals and display position on the screen



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8. Input Signals, Basic Display Colors and Gray Scale of Each Color

Colors & Gray scale		Data signal																		
		Gray Scale	R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
Basic Color	Black	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	—	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Green	—	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	—	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Red	—	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	—	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1
	Yellow	—	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	White	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Brighter	GS61	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	↓	GS62	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS63	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑	GS1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Brighter	GS61	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	0
	↓	GS62	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
	Green	GS63	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0
Gray Scale of Blue	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑	GS1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Brighter	GS61	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
	↓	GS62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
	Blue	GS63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1

0 : Low level voltage, 1 : High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. According to the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

9. Optical Characteristics

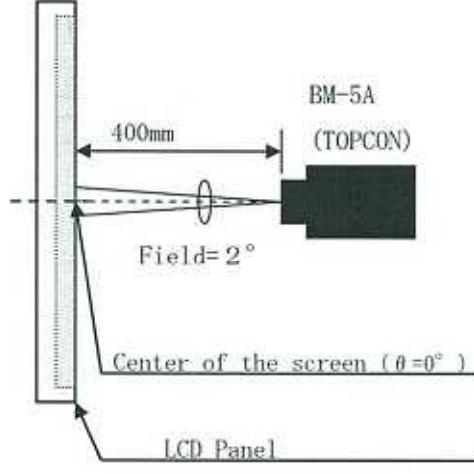
Ta=+25°C, Vcc=+3.3V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	θ_{21} , θ_{22}	CR>10	45	—	—	Deg.	[Note 1,2,3]
		θ_{11}		10	—	—	Deg.	
	Vertical	θ_{12}		30	—	—	Deg.	
Contrast ratio		CRn	$\theta = 0^\circ$	300	—	—		[Note 1,3,5]
		CRo	Optimum viewing angle	300	500	—		
Response time		$\tau_r + \tau_d$	$\theta = 0^\circ$	—	30	40	ms	[Note 1,4,5]
Chromaticity of white		x		0.283	0.313	0.343		[Note 1,5]
		y		0.299	0.329	0.359		
Color gamut (NTSC ratio)				—	50	—	%	[Note 1,5]
Luminance of white		Y _u		170	210	—	cd/m ²	[Note 1,6]
White Uniformity		δ_w		—	1.20	1.45		[Note 1,7]

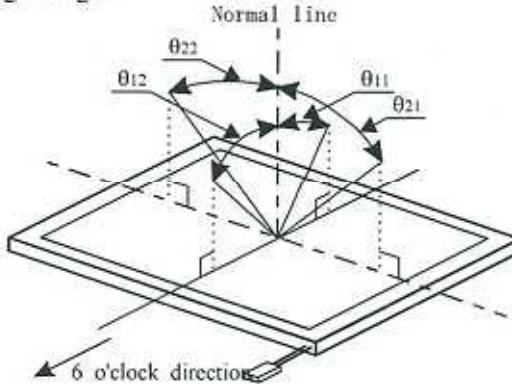
The measurement shall be executed 30 minutes after lighting at rating. Condition : (I_L=6.0mArms)

The optical characteristics shall be measured in a dark room or equivalent.

[Note 1] Optical Characteristics Measurements



[Note 2] Definitions of viewing angle range:



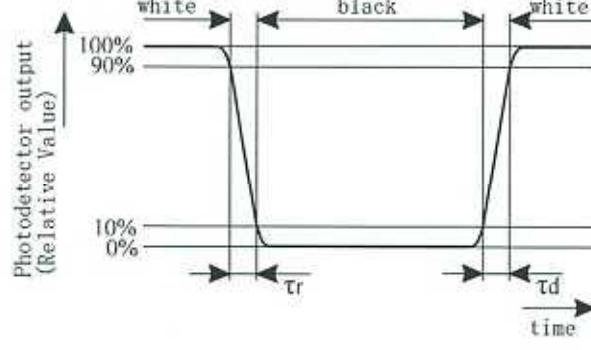
[Note 3] Definition of contrast ratio:

The contrast ratio is defined as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

[Note 4] Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



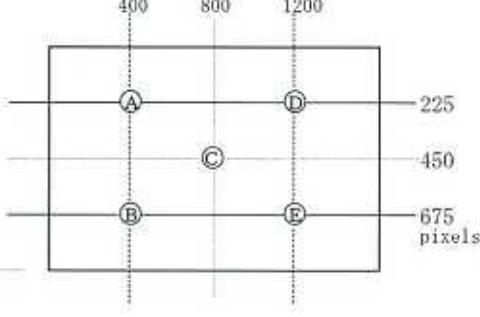
[Note 5] This shall be measured at center of the screen.

[Note 6] Average of five point.(A~E)

[Note 7] Definition of white uniformity:

White uniformity is defined as the following with five measurements (A~E).

$$\delta w = \frac{\text{Maximum Luminance of five points (brightness)}}{\text{Minimum Luminance of five points (brightness)}}$$



10. Display Quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

11. Handling Precautions

- a) Be sure to turn off the power supply when inserting or disconnecting the cable.
- b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.
- c) Since the front polarizer is easily damaged, pay attention not to scratch it.
Blow away dust on the polarizer with antistatic N₂ blow. It is undesirable to wipe off because a polarizer is sensitive.
It is recommended to peel off softly using the adhesive tape when soil or finger oil is stuck to the polarizer.
When unavoidable, wipe off carefully with a cloth for wiping lenses.
- d) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.
Handle with care.
- g) Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling.
Observe all other precautionary requirements in handling components.
- h) Since there is a circuit board in the module back, stress is not added at the time of a design assembly.
Please make it like. If stress is added, there is a possibility that circuit parts may be damaged.
- i) Protection film is attached to the module surface to prevent it from being scratched.
Peel the film off slowly, just before the use, with strict attention to electrostatic charges.
Blow off 'dust' on the polarizer by using an ionized nitrogen.
- j) Do not expose the LCD module to a direct sunlight, for a long period of time to protect the module from the ultra violet ray.
- k) Connect GND of mounting holes to stabilize against EMI and external noise.
- l) When handling LCD modules and assembling them into cabinets, please avoid that long-terms storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the modules.
- m) Cold cathode fluorescent lamp in LCD panel contains a small amount of mercury, please follow local ordinances or regulations for disposal.
- n) Be careful of a back light lead not to pull by force at the time of the wiring to an inverter, or line processing.
- o) When install LCD modules in the cabinet, please tighten with "torque = 0.196 N·m(Max).
Be sure to confirm it in the same condition as it is installed in your instrument.
- p) Liquid crystal contained in the panel may leak if the LCD is broken. Rinse it as soon as possible if it gets inside your eye or mouth by mistake.
- q) Notice : Never dismantle the module, because it will cause failure.
Please don't remove the fixed tape, insulating tape etc that was pasted on the original module.
(Except for protection film of the panel and the crepe tape (yellow tape) of fixing lamp cable temporarily.)
- r) Be careful when using it for long time with fixed pattern display as it may cause afterimage.
(Please use a screen saver etc., in order to avoid an afterimage.)
- s) Adjusting volume has been set optimally before shipment, so do not change any adjusted value.
If adjusted value is changed, the specification may not be satisfied.
- t) The lamp used for this product is very sensitive to the temperature.
Luminance decreases rapidly when it is used for a long time or repeatedly under the environment of the low temperature or the module is being cooled.
Please avoid the continuous or repeating use of it under such an environment.

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12. Packing form

Parameter	
Piling number of cartons	Max.6
Package quantity in one carton	10 pcs
Carton size	470(W)×335(D)×313(H) mm
Total mass of one carton filled with full modules	8.3kg
Packing form	Fig.1

13. RoHS Regulations

This LCD module is compliant with RoHS Directive.

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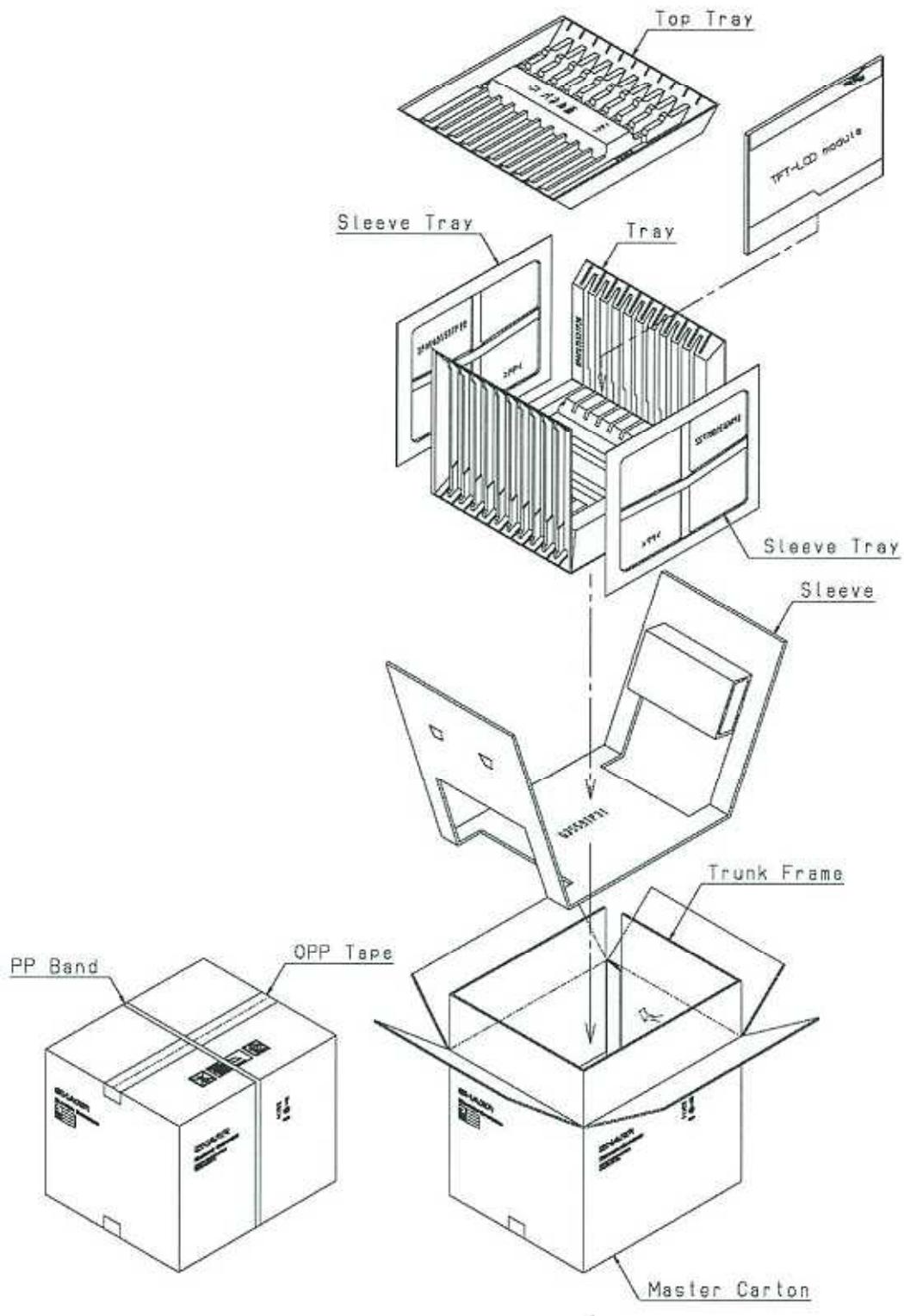


Fig. 1 Packing form

LD-200852A-19

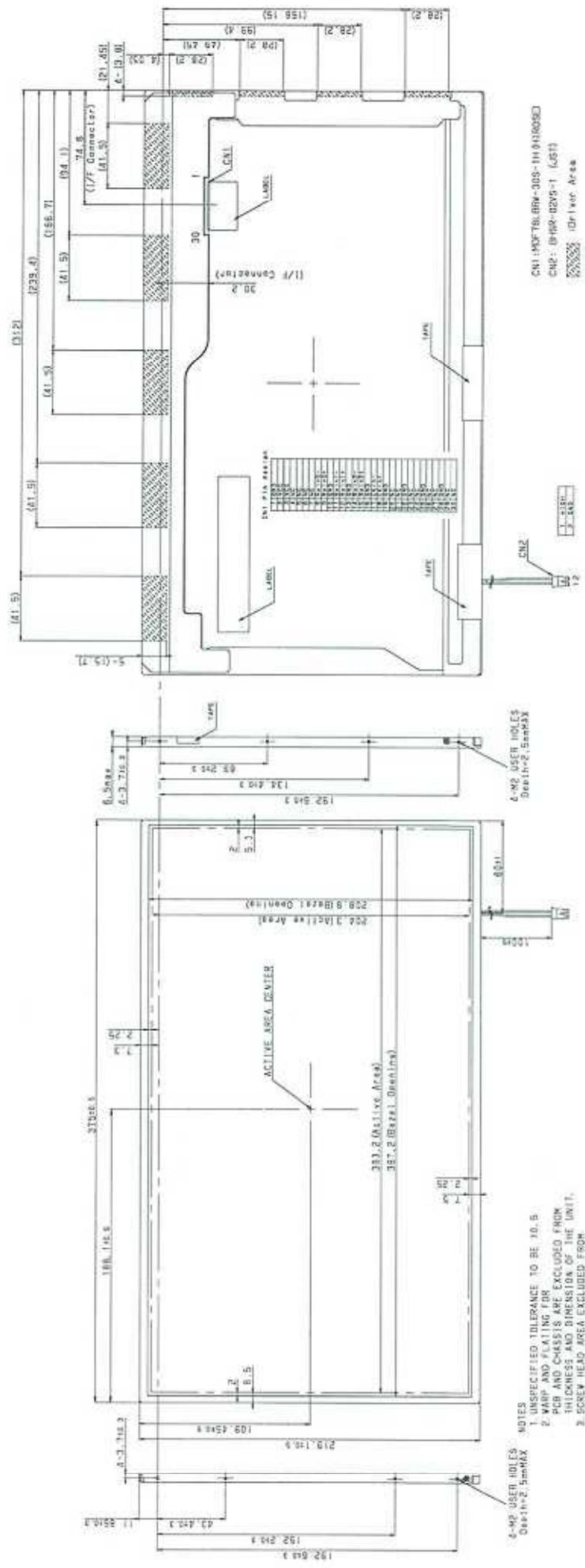


Fig. 2 Outline Dimensions